UNITED STATES PATENT APPLICATION

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Invention: ROADWAY BARRIER COMPONENTS FORMED USING A SYSTEM FOR RECYCLING WET CONCRETE AND MEANS FOR ASSEMBLING MULTIPLE COMPONENTS INTO A CONTINUOUS SAFETY BARRIER WALL

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CROSS-REFERENCE TO RELATED APPLICATIONS

This application is related to U.S. Provisional Application Serial Number 60/535,450, filed 8 January 2004, entitled "System for recycling wet concrete into precast structures and structures formed thereby."

BACKGROUND OF THE INVENTION

1. Field of the Invention.

The present invention relates to efficiently recycling concrete waste from ready-mix cement trucks. More particularly, the present invention relates to roadway barrier components formed using a system for recycling excess wet concrete, and means for assembling the individual components into a continuous safety barrier wall.

2. Discussion of the Background.

Often times ready-mix concrete trucks return to the cement yard at the end of the workday with relatively large amounts of excess fresh concrete. This excess fresh concrete must be disposed of or recycled in some manner, so that the cement trucks may be cleaned for the next day's operations.

The typical disposal process has long involved wetting down the concrete within the mixing truck itself to significantly dilute it, and then dumping the wet concrete. This wet concrete is then held in a bin for approximately five days, during which time the particulate separates from the water. After separation of the excess water, the solid material is moved to

a drying bin and after some period it is transported to a landfill. This disposal process results in a significant waste of refuse solid material, and a large added cost of transportation and disposal of the refuse solid material. Moreover, cities are now beginning to wrestle with the problem of storing refuse solid material inasmuch as vast piles of it are collecting at many landfills. As a result, a number of processes have been attempted to recycle the residual concrete, albeit all have generally been directed towards recovery of the concrete aggregate (i.e. landfill material).

One method, well-known in the industry, for recycling excess fresh concrete includes having the mixing truck operators dump the excess concrete into on-site molds. Once the concrete hardens it is removed from the mold and fed into a breaking, or crushing device. The concrete is broken or ground into small pieces which are sold to construction sites for use as base fill for foundation, sub-foundation, or roadbed projects.

Other examples of recycling excess concrete are found in U.S. Patent Nos. 5,908,265 to Mostkoff (disclosing a method and apparatus for producing concrete shapes suitable for use in forming an artificial reef using ready mix cement trucks with excess load to blend measured amounts of concrete and tire chips), 5,766,524 to Rashwan et al. (disclosing a method and apparatus for the reclamation of excess concrete returned to the cement yard by cement delivery trucks using molds designed to produce blocks of concrete suitable for regrinding into aggregate), and 3,786,997 to Viner (disclosing a wet concrete reclamation method and apparatus in which unused concrete is poured and formed, and then crushed into little pieces).

Additionally, the use of molds to form concrete into various component shapes is also well-known in the industry. For example, U.S. Patent No. 5,096,648 to Johnson et al.

discloses a mold system for producing paving stones that employs a plurality of slidably mounted molds, and U.S. Patent No. 4,067,941 to Gaudelli et al. discloses a mold for producing multiple slabs of concrete. However, the conventional techniques for molding concrete into pre-cast components such as paving stones or simple slabs are not suitable for the contemplated uses of the components molded from the recycled material of the present invention for the following reasons. Historically, the process of removing the hardened concrete components from molds is time consuming and expensive because great care must be taken to ensure that the molded component is not damaged. Moreover, the strength of any resulting pre-cast component is compromised by the lack of an internal reinforcing structure (e.g. rebar). Finally, the resulting components are not easily manipulated and stacked because they are not made with attachable lifting handles.

Therefore, there remains a need in the art for an efficient and cost effective system for recycling excess wet concrete from ready-mix concrete trucks into components that may be put to beneficial use. To the best of the knowledge of the present inventor, no prior art system addresses this need. A system of this type should provide for the pouring of residual wet concrete into molds to make pre-cast components such as roadway barrier sections (i.e. jersey walls) and the like. Once the concrete has set, the resulting components should be easy to remove from the mold and stackable so that they may be stored or displayed for sale. Reinforcing materials, lifting handles, and/or elements that assist in the assembly of two or more components should be included to make the concrete components stronger and easier to manipulate and configure. The structures assembled from two or more of the concrete components should be inexpensive, easily constructed, and permanent or temporary in nature.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide components formed by an efficient and cost-effective system that recycles wet concrete waste material from ready-mix cement trucks into "residual-collection" molds.

It is another object of the present invention to provide components formed from recycled wet concrete that are easily removed from the molds.

Yet another object of the present invention is to provide components formed from recycled wet concrete that are ready-to-use and structurally sound.

It is another object of the present invention to provide components formed from recycled wet concrete such as roadway barrier sections and the like.

An additional object of the present invention is to provide components formed from recycled wet concrete that include attachable lifting handles or rings for easy handling on a work site.

Still another object of the present invention is to provide components formed from recycled wet concrete that include reinforcing materials to increase structural strength.

Another object of the present invention is to provide components formed from recycled wet concrete that include elements that assist in assembling two or more components.

It is another object of the present invention to provide components formed from recycled wet concrete that are stackable so that they may be readily stored or displayed for sale.

Yet another object of the present invention is to provide components formed from recycled wet concrete that are inexpensive to manufacture and sell.

An additional object of the present invention is to provide structures comprising one or more of the recycled concrete components that are inexpensive and easily constructed.

Still another object of the present invention is to provide structures comprising one or more of the recycled concrete components that are permanent or temporary in nature.

The present invention addresses these and other objects by providing a system that begins with concrete mixing trucks returning to the cement plant throughout the workday. "Residual-collection" molds, kept on-hand at the plant, are filled with any excess wet concrete present in the returning trucks. The molds are configured to form pre-cast components such as roadway barrier sections (i.e. jersey walls), and the like.

Once the concrete has set, the resulting pre-cast components are strong, yet easy to remove from the molds and manipulate (e.g. stack), due to the presence of integral reinforcing materials and attachable lifting handles/rings. In that way, they may be stored or displayed for sale. Also integral to the finished concrete components are elements that assist in the assembly of two or more components. The pre-cast components are low in cost due to the use of recycled wet concrete, inexpensive reinforcing materials (e.g. "rebar", wire mesh), and handles/assembly elements fabricated from other recycled materials (e.g. PVC). The finished concrete components (e.g. roadway barrier sections) may be sold or leased to customers. This converts the incremental costs typically associated with traditional residual concrete disposal techniques into supplemental income streams based upon the present invention's novel use of recycled wet concrete.

The lifting handle/ring may be a pre-engineered, attachable, plastic (e.g. recycled PVC) eye bolt capable of supporting 300% of the pre-cast component's weight. The elements that assist in the assembly of two or more of the pre-cast concrete components may be injection

molded from plastic materials such as recycled PVC. Some of the assembly elements may be fabricated of cylindrical sections of PVC. The assembly elements comprise items that are an integral part of the finished concrete components, and items that may be temporarily or permanently attached to the finished concrete components. The attachable/detachable elements include pre-engineered connector hooks and eye bolts.

Once complete, the pre-cast recycled concrete components may, for example, be assembled into a continuous roadway safety barrier wall. All structures assembled from two or more of the concrete components are inexpensive due to the low cost of the individual components, easily constructed, and may be permanent or temporary in nature.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a casting bed 15 including a plurality of molds 18 (or "forms") used to create roadway barrier sections according to a preferred embodiment of the present invention.

FIG. 2 is a cross-sectional view of the casting bed 15 and forms 18 taken along line A-A in FIG. 1.

FIG. 3 is a cross-sectional side view of a roadway barrier section 40 according to a preferred embodiment of the present invention.

FIG. 4 is a cross-sectional view of the barrier section 40 taken along line B-B in FIG. 3.

FIG. 5 is a cross-sectional view of the barrier section 40 taken along line C-C in FIG. 3.

FIG. 6 is a side perspective view of an anchoring member 54 according to a preferred embodiment of the present invention.

FIG. 7 is a side perspective view of a three-way connector 46 according to a preferred embodiment of the present invention.

FIG. 8 is a side perspective view of a connector rod 47 according to a preferred embodiment of the present invention.

FIG. 9 is a side perspective view of a connector rod 45 according to a preferred embodiment of the present invention.

FIG. 10 is a side perspective view of an eye bolt 51 according to a preferred embodiment of the present invention.

FIG. 11 is a side perspective view of a connector hook 50 according to a preferred embodiment of the present invention.

FIG. 12 is a cross-sectional view of two barrier sections 40 connected via the combination of an eye bolt 51 and a connector hook 50.

DETAILED DESCRIPTION

The present invention is pre-cast roadway barrier components fabricated of the recycled excess or residual wet concrete remaining in ready-mix concrete trucks after completion of a job, and the means for assembling the individual components into a continuous safety barrier wall.

The recycling of the excess or residual wet concrete begins with the mixing trucks returning to the plant during and at the end of the workday. "Residual-collection" molds are kept on-hand at the plant, and as the ready-mix cement return they evacuate their excess wet concrete into the residual-collection molds. The molds are configured to form pre-cast structural components such as roadway barrier sections, and the like.

FIGs. 1 and 2 are, respectively, plan and cross-sectional views of a casting bed 15 including a plurality of molds 18 used to create roadway barrier sections according to a preferred embodiment of the present invention.

As stated above, at the end of a workday it is common for returning trucks to be carrying a significant amount of excess wet concrete (e.g. more than a quarter cubic yard). To recycle this wet concrete, portable or stationary "residual-collection" molds 18 are kept on-hand at the plant, and as the ready-mix cement trucks return they evacuate their excess wet concrete into the residual-collection molds 18. Over the course of days or weeks the molds 18 are filled to create a plurality of completed, precast roadway barrier sections as will be described. Upon completion, the sections are removed and inventoried, and the process begins anew. In the meantime, the completed barrier sections are sold or leased to customers. This not only avoids the incremental cost associated with the traditional disposal of concrete aggregate, but also produces a supplemental income stream from it.

The "residual-collection" molds 18 of the present invention include a casting bed 15 for molding concrete into roadway barrier sections. FIGs. 1 and 2 are, respectively, plan and cross-sectional views of a casting bed 15 including a plurality of molds 18 (or "forms") used to create barrier sections according to a preferred embodiment of the present invention. The casting bed 15 is comprised of rectangular steel plate flooring 14, two steel plate external perimeter walls 16, a plurality of lengthwise steel internal walls 17, and a plurality of widthwise steel plate bulkheads 13.

The barrier sections are cast in an upside-down position wherein the curvature of the internal walls 17 provides the barrier sections with their familiar tapered configuration. The bulkheads 13 are formed with a central protrusion 19 to create a vertically-oriented recess in

the finished barrier section (see FIG. 5). Typically, the internal walls 17 are fixedly attached (e.g. tack welded) to the external walls 16 along the seam where they meet. The bottom of each wall 16, 17 and each bulkhead 13 are detachably attached to the steel plate flooring 14 to ensure that the cast form may be easily removed from the mold 18 once set.

Given that it is common for returning trucks to be carrying a significant amount of excess wet concrete (i.e. more than a quarter cubic yard), a mold 18 configured to produce a 12' long barrier section with the standard profile (i.e. a 24" wide base tapering to 6" across at the top, with an overall height of 32") is ideally suited to the present invention. A mold 18 constructed to the above dimensions holds approximately 0.9 cubic yards of concrete, thereby requiring the excess material typically present in only three or four returning trucks. Those skilled in the art will recognize that barrier sections with dimensions varying from those mentioned above may be cast using molds 18 and casting beds 15 similar to that described in association with the preferred embodiment of the present invention.

FIGs. 3-5 provide a series of cross sectional views of a roadway barrier section 40 according to a preferred embodiment of the present invention. The beneficial uses of the barrier sections 40 are limited only by their non-specified compressive strength and one's imagination. The preferred barrier section 40 includes a top 41, a base 42, two opposing symmetrical ends 43 and two opposing symmetrical sides 44. Preferably, the letters "RC" are embossed at one or more places along the top 41 to indicate that the barrier section 40 is fabricated of recycled concrete. The presence of two central protrusions 19 in each mold 18 (see FIG. 1) forms a vertically oriented recess 39 in each end 43 of a barrier section 40. As described above, the height of the section 40 is preferably 32", the length is preferably 12 feet, the width at the base 42 is preferably 24", and the width at the top 41 is preferably 6".

Roadway barrier sections (i.e. jersey walls) 40 of this size are, relatively speaking, light enough to be manipulated (i.e. stacked, displayed for sale) by readily available equipment. The barrier sections 40 are preferably formed with integral reinforcement such as a commercially available sheet 38 of welded wire mesh positioned proximate the section's central (widthwise) axis and running along its entire length. Those skilled in the art will appreciate that other forms of concrete reinforcement (e.g. steel rebar) may also be suitable for the purpose of reinforcing the barrier sections 40 of the present invention.

The barrier sections 40 are also preferably formed with a series of integral components, forming an internal assembly, that facilitate the lifting and transportation of the sections 40, as well as the assembly of two or more of them into a continuous roadway safety barrier wall. The integral components cast within each section 40 include, as shown in FIGs. 6-9 respectively, anchoring members 54, three-way connectors 46a-b, connector rods 47a-c, and connector rod 45.

The anchoring member 54 of FIG. 6 is preferably injection molded as a single component from a plastic material such as recycled PVC and includes a base 61 and a neck 62 with male Acme threads 63 formed in one end.

The three-way connectors 46a-b of FIG. 7 are preferably injection molded as single "T"-shaped components from a plastic material such as recycled PVC and include female Acme threads 65a-c formed in the three ends of the "T".

The connector rods 47a-c of FIG. 8 are preferably injection molded as single tubular components from a plastic material such as recycled PVC and include female Acme threads 66 formed in one end and male Acme threads 67 formed in the opposite end.

The connector rod 45 of FIG. 9 is preferably injection molded as a single tubular component from a plastic material such as recycled PVC and includes male Acme threads 69 formed at both ends. Those skilled in the art will recognize that other suitable materials and means of fabrication may be used in the manufacture of the anchoring members 54, three-way connectors 46a-b, connector rods 47a-c, and connector rod 45.

Referring back to FIGs. 3 and 5, in the preferred embodiment of the present invention, an internal assembly, comprising one anchoring member 54, two three-way connectors 46a-b, three connector rods 47a-c, and one connector rod 45, is cast into each end of each barrier section 40 by positioning it vertically within the mold 18 before any excess wet concrete has been poured into the mold 18. The internal assembly is positioned in the mold 18 such that it is coplanar with the central, vertical plane running the length of each barrier section 40. The internal assembly is proximate, and may be fixedly attached to, the sheet 38 of reinforcing wire mesh that is preferably cast into each section 40.

The internal assembly is formed by screwing the male threads 63 of the anchoring member 54 into the female threads 65a of the three-way connector 46a. The male threads 67 of the connector rod 47a are then screwed into the female threads 65b of the three-way connector 46a. The male threads 69a of the connector rod 45 are then screwed into the female threads 65c of the three-way connector 46a. The female threads 65a of the three-way connector 46b are then screwed onto the male threads 69b of the connector rod 45. The male threads 67 of the connector rod 47b are then screwed into the female threads 65b of the three-way connector 46b. Finally, the male threads 67 of the connector rod 47c are screwed into the female threads 65c of the three-way connector 46b.

The internal assembly is positioned such that the openings of the female threads 66 of the connector rods 47a-b are flush with the end surface 37 of the recess 39 formed in the end 43 of the finished barrier section 40, and the opening of the female threads 66 of the connector rod 47c is flush with the top 41. Preferably, this is accomplished when the internal assembly's connector rod 45 is positioned approximately two feet from the end 43 of the barrier section 40.

Additionally, in order for the barrier sections 40 to be easily manipulated after removal from the molds 18, the sections 40, as described above, are formed such that one or more lifting handles/rings 51 (e.g. eye bolts – see FIG. 10) may be detachably attached. For safety reasons, the lifting handles/rings should be rated to hold up to 300% of the section's weight. In the preferred embodiment of the present invention, two pre-engineered plastic (e.g. recycled PVC) eye bolts 51, each formed with male Acme threads 55, are screwed into the female threads 66 of the connector rods 47c located proximate each end 43 of the barrier section 40. Practically, the eye bolt 51 should extend approximately four inches above the top 41 of the barrier section 40 to allow a standard hook connected to a piece of lifting equipment (e.g. a front-end loader with a boom) may be used to lift and move the barrier section 40.

The preferred barrier section 40 described herein comprises two points of attachment for lifting rings/eye bolts 51 located along the top 41 of the section 40. However, those skilled in the art will recognize that, depending upon the dimensions and associated weight of the barrier section 40, the number of lifting points available along the top 41 may vary.

In place of an eye bolt 51, such as when two or more barrier sections 40 have been assembled into a continuous roadway safety barrier wall in the manner described below, a

reflector (not shown in the Figures) may be screwed into the female threads 66 of the connector rods 47c.

A continuous roadway safety barrier wall may be assembled from two or more barrier sections 40 using the internal assemblies of anchoring members 54, three-way connectors 46a-b, connector rods 47a-c, and connector rods 45 as shown in FIG. 3, the eye bolts 51 of FIG. 10, and the connector hooks 50 of FIG. 11. Each eye bolt 51 is preferably injection molded as a single component from a plastic material such as recycled PVC and includes a doughnut 53 and a neck 54 with male Acme threads 55 formed at one end. Each connector hook 50 is preferably injection molded as a single component from a plastic material such as recycled PVC and may include a section 58 shaped substantially like the number "7" with male Acme threads 59 formed at one end. Those skilled in the art will recognize that other suitable materials and means of fabrication may be used in the manufacture of the eye bolts 51 and connector hooks 50.

FIG. 12 shows the manner in which an end of one barrier section 40 may be connected to an end of another section 40'. First, the male threads 55 of a connector ring/eye bolt 51 are screwed into the female threads 66 of the connector rod 47b. The eye bolt 51 should be positioned such that the plane of the doughnut 53 is parallel to the surface on which the barrier section 40 rests, with the doughnut 53 positioned in the recess 39 at the end of the barrier section 40 such as shown in FIG. 5. A second eye bolt (not shown in the Figures) is similarly screwed into the connector rod 47a (see FIG. 3) positioned toward the base 42 of the section 40.

Then, the male threads 59 of a connector hook 50 are screwed into the female threads 66 of the connector rod 47b'. The connector hook 50 should be positioned such that an axis

passing through the top section of the "7" is perpendicular to the surface on which the barrier section 40' rests, with the free end of that top section pointing downward toward the surface. A second connector hook (not shown in the Figures) is similarly screwed into the connector rod (not shown in the Figures) positioned toward the base (not shown in the Figures) of the section 40'.

The two barrier sections 40, 40' may then be detachably attached by screwing an eye bolt into the connector rod (see, for example, FIG. 3) at the top of the section 40' with the connector hooks 50, lifting that section 40' with an appropriate piece of equipment, aligning the top sections of the hooks 51 with the holes in the doughnuts 53 of the eye bolts 51, and lowering the section 40' such that the hooks 50 engage the eye bolts 51 in the manner shown in FIG. 12. When done properly, the ends of the barrier sections 40, 40' are positioned very close to, if not just touching, one another. The interaction of the hooks 50 and the eye bolts 51 combined with the weight of each barrier section 40, 40' keep the resulting roadway safety barrier wall properly assembled/connected under all but the most extreme circumstances.

Having now fully set forth the preferred embodiments and certain modifications of the concept underlying the present invention, various other embodiments as well as certain variations and modifications of the embodiments herein shown and described will obviously occur to those skilled in the art upon becoming familiar with said underlying concept. It is to be understood, therefore, that the invention may be practiced otherwise than as specifically set forth in the appended claims.